



Space Operations Services Grid Project

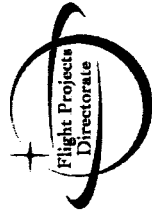
Outline



- Motivation & Goals
- Background
- Space Operations Services Grid Project
- Deliverables
- Benefits



Space Operations Services Grid Project



SpaceOps 2004

Montreal, Canada

Spaceflight Operations Services Grid (SOSG) Project

May, 2004

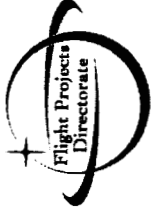
DRAFT PRESENTATION

January 22, 2004



Space Operations Services Grid Project

Motivation

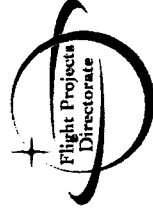


The Payload Operations Integration Center (POIC) provides operational services and/or coordination for all International Space Station on-board scientific payloads and experiments

- Statement of Problem
 - Science disciplines for the most part cannot interact at the data level because data is heterogeneous and distributed
 - Disparate organizations and systems providing spaceflight operational services (i.e. voice, video, telemetry, command) that are stove piped resulting in duplicated services across systems that do interact well or at all



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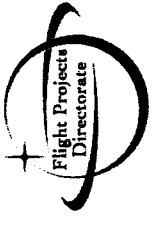
Motivation (cont)

- Hypothesis
 - Applying Grid technologies will:
 - Provide new and improved services to the Principal Investigator and Control Center environments
 - Improves security end to end
 - Provide common support services that can be reused by applications to simplify application development
 - user attribute database
 - information distribution
 - data storage facilities
 - method of authentication and authorization
 - Enable an application development framework that leverages all common services and speaks a common protocol for management and control to make application development easier and cost efficient
 - Provide single interface to use and access POIC provided applications



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Motivation (cont)



- Resulting in:
 - Enabling inter-discipline science collaboration creating new information and knowledge
 - Making current systems/applications supporting spaceflight activities more economical
 - Reducing development costs for future spaceflight system development, replacements and upgrades



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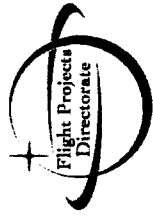
Goals and Objectives



- Develop a Grid-enabled prototype providing Space-based ground operations end user services through a collaborative effort between NASA, academia and industry to assess the technical and cost feasibility of implementation of Grid technologies in the Space Operations arena by:
 - Hands on implementation of the prototype
 - Assessment of services by actual space operations principal investigators/scientists
 - And, management review
- Provide to space operations organizations and processes, through a single secure portal(s), access to all the information technology (Grid and Web based) services necessary for program/project development, operations and the ultimate creation of new processes, information and knowledge:
 - Innovative approaches to problem solving
 - Tools to access archived and real-time data to develop new types of information and knowledge
 - Tools to enable engineering and scientific collaboration on a new level
 - Tools to enable increases in productivity with existing processes and operations



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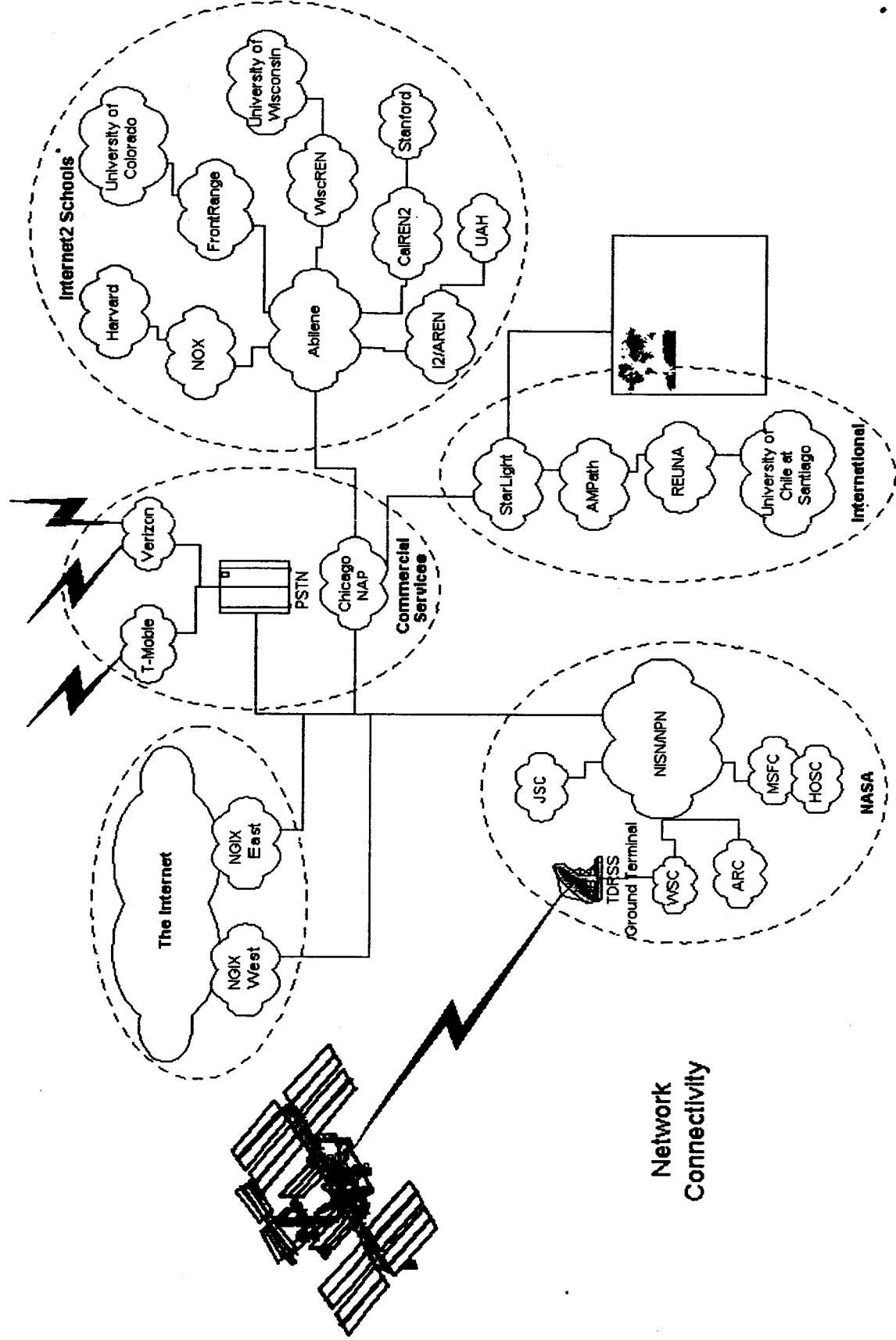
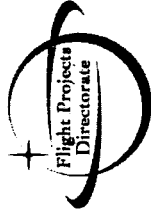


Background



Space Operations Services Grid Project

Network Service Overview Supporting the SOSG





Space Operations Services Grid Project

User-based Service Status

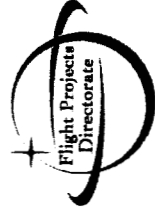


<u>Service:</u>	<u>Base System</u>	<u>Base Sys Status</u>	<u>Definition:</u>
1. Data/Telemetry Mgt	TReK	Operational	Provide TReK telemetry management services http://trek.msfc.nasa.gov
2. Experiment/System CMD Mgt	TReK	Operational	Provide TReK command management services http://trek.msfc.nasa.gov
3. ISS DL Video Distribution	GViDS	SBIR Ph 2 Dev	Provide varying bandwidth rates to all VOs, sense native network and adjust rate
4. Web Measure Delivery w/Wireless	TReK/EZStream	Operational	Provide individual measurements over the Web and to wireless devices
5. High Performance Processing	ARC/IPG	Operational	Access massively parallel and other processing cycles in real and near real-time
6. Data Mining	UAH Data Mining	Operational	Analyze and combine new and archived data to find new information and knowledge
7. High Volume Network Storage	UAH NW Storage	Operational	Use massive storage capabilities through the Web securely
8. Mission Voice	IVoDS	Operational	Access the mission voice loops provided by IVoDS http://ivods.msfc.nasa.gov
9. Collaborative Internet Voice	CVoDS	SBIR Ph 2 Dev	Upgrade to IVoDS to provide application sharing, IM, video telecon and mission voice
10. Video Auditorium	Video Auditorium	In final test phase	A new approach to video teleconferencing still in development
11. Application Sharing			Ability for a user to "plug in" discipline specific applications under the Grid services umbrella
11. a. Antenna Pointing System	Antenna Pointing Sys	Operational	
11. b. Shuttle Flight Data Mine	UAH Data Mining	Requires develop	
12 System Perf. & Measurement	TBD	TBD	For the prototype and beyond measure network and application performance
13 Networks Connectivity	NREN/NPN/Abilene	Operational	All the network connectivity from the prototype to the users
14 Network Service	TBD	TBD	



Space Operations Services Grid Project

Grid Overview



- Grids provide the infrastructure
 - To dynamically integrate independently managed:
 - Compute resources
 - Data sources
 - Scientific Instruments (Wind Tunnels, Microscopes, Simulators, etc.)
 - To build large scale collaborative problem solving environments that are:
 - Cost effective
 - Secure
- Grid software is “middleware”

A Grid Enabled Infrastructure



Resources



Networks

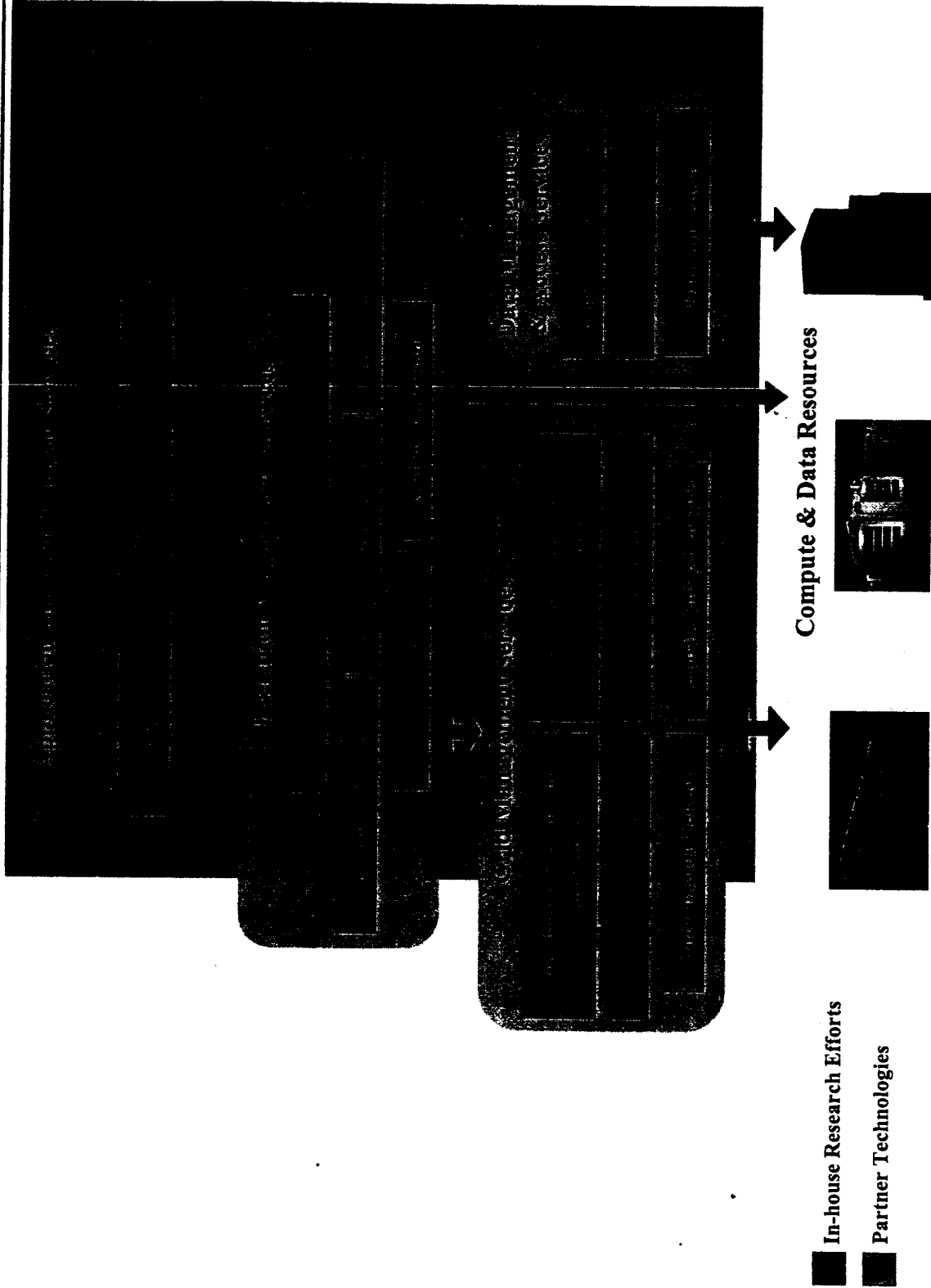
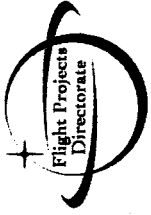


Grid Middleware



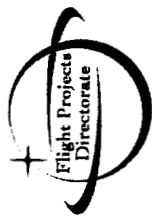
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Current Grid Technologies Research at NASA Ames





Space Operations Services Grid Project



Space Operations Services Grid (SOSG) Project

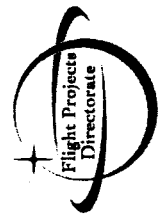


Space Operations Services Grid Project

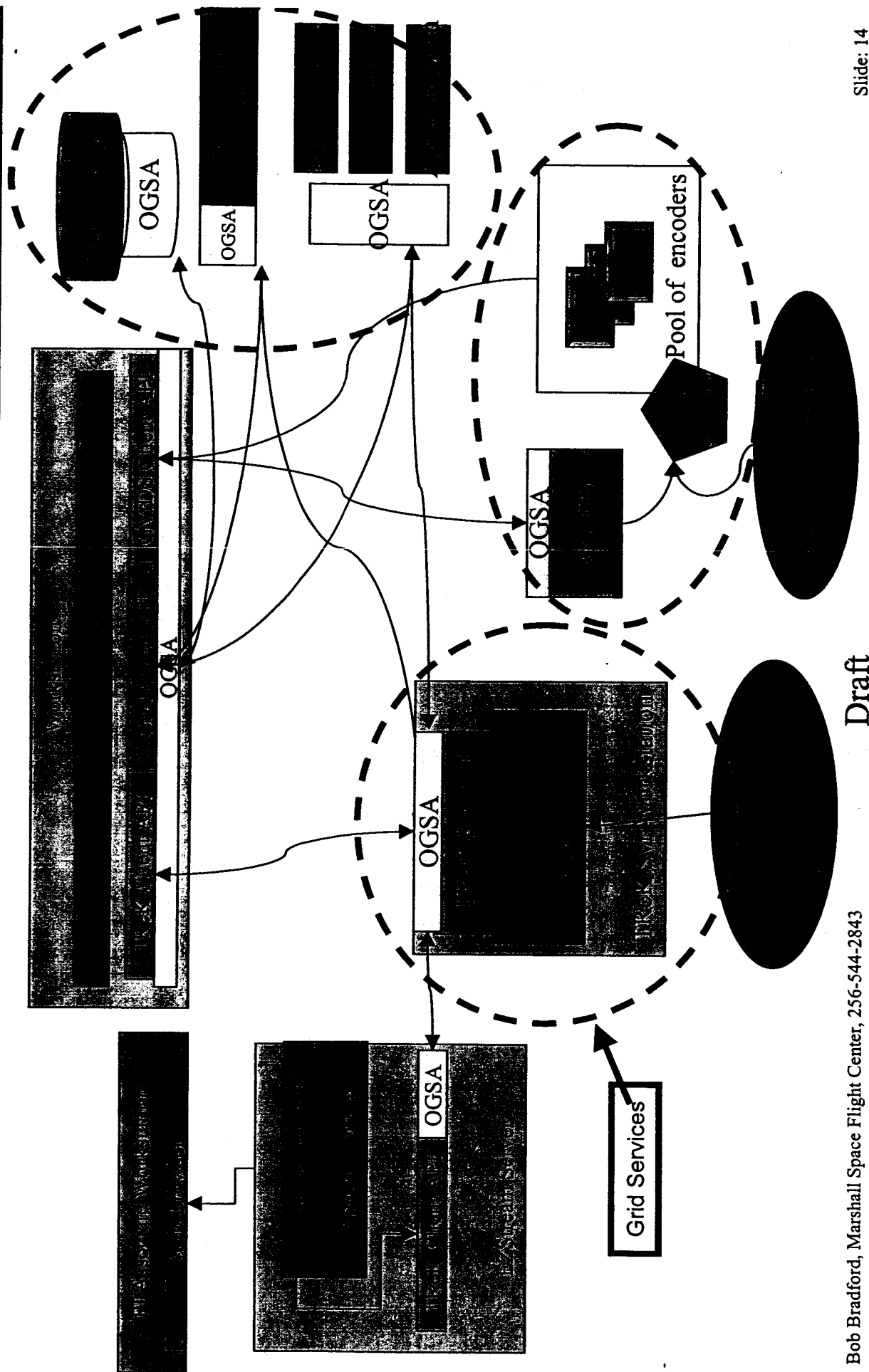
Approach



- Apply Grid technologies to Space Flight Operations by developing a service based prototype to incorporate three levels of Grid-based services:
 - User based, Grid based and Network Infrastructure
- Use ISS POIC ground services as the basis for user service prototyping in a non-operational environment
- Develop virtual organizations (VOs) to target four end-user communities:
 - Payload operations (both Payload Control Center and Principal Investigator Operations)
 - Flight Control Center Operations
 - Educational Outreach
- Develop a quasi-operational Grid-based prototype encompassing current and new space flight operational services with integration of at least one specific scientific tool



SOSG: Software Architecture Concept





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User-based Service Status

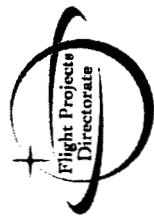


<u>Service:</u>	<u>Base System</u>	<u>Base Sys Status</u>	<u>Web/Grid Enabled?</u>
1. Data/Telemetry Mgt	TReK	Operational	No
2. Experiment/System CMD Mgt	TReK	Operational	No
3. ISS DL Video Distribution	GVIDS	SBIR Ph 2 Dev	Web
4. Web Measure Delivery w/Wireless	TReK/EZStream	Operational	Web
5. High Performance Processing	ARC/TPG	Operational	Grid
6. Data Mining	UAH Data Mining	Operational	Grid
7. High Volume Network Storage	UAH NW Storage	Operational	Grid
8. Mission Voice	IVoDS	Operational	Web
9. Collaborative Internet Voice	CVoDS	SBIR Ph 2 Dev	Web
10. Video Auditorium	Video Auditorium	In final test phase	Web
11. Application Sharing			
11. a. Antenna Pointing System	Antenna Pointing Sys	Operational	No
11.b. Shuttle Flight Data Mine	UAH Data Mining	Requires develop	No
12 System Performance & Measurement	TBD	TBD	TBD
13 Networks Connectivity	NREN/NPN/Abilene	Operational	NA
14 Network Service	TBD	TBD	TBD



Space Operations Services Grid Project

VO Predominate Service Summary

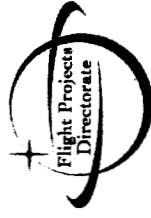


<u>Service:</u>	<u>Virtual Organization:</u>	<u>Payload (PL) Operations</u>		<u>Flight Ctrl Ctr Ops</u>	<u>Outreach</u>
		<u>PL Control Ctr Ops</u>	<u>Science Ops</u>		
1. Data/Telemetry Mgt		X	X	X	
2. Experiment/System CMD Mgt		X			
3. ISS DL Video Distribution		X	X	X	X
4. Web Measure Delivery w/Wireless		X	X	X	X
5. High Performance Processing		X	X	X	
6. Data Mining		X	X	X	
7. High Volume Network Storage		X	X	X	X
8. Mission Voice		X	X	X	
9. Collaborative Internet Voice			X		
10. Video Auditorium		X	X	X	X
11. Application Sharing			X		X
12. System Performance & Measurement		X		X	
13. Networks Connectivity		X	X	X	X



Space Operations Services Grid Project

Grid-based Common Services



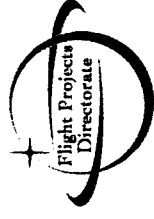
- Integrated Services Portal*
 - Contains all services offered by the POIC through the Grid Prototype. It is a capture portal in that a user must use this portal to fire up services. It will dynamically generate web content based on who the user is. i.e. If a public user, then access directly to TReK will not be listed
- Application Creation Service*
 - Used to specify and create the applications needed by a user, e.g., TReK, EZStream, IVoDS, GViDS
- Broker Service (ARC)
 - Uses grid information service to locate and select resources to run services
- Naturalization Service (ARC)
 - Sets up host environment to run specific applications
- Execution Service (ARC)
 - Used to launch applications
- Event Monitoring Service (ARC)
 - Service for publishing and subscribing to various systems and user defined events

* Services to be developed



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Grid-based Common Services (cont)



- Virtual Organization/Profile Database*
 - Contains information about virtual org. make up and participants
 - Contains information about all SOSG users
 - Role, permissions, applications, privileges, etc
 - MyProxy (Globus)
 - Credential repository, proxy repository, Credential Management
 - Grid Information Services (GIS Globus)
 - Publishes information about resources and services
 - Network Activation Service (ARC)
 - A service that can make changes in the network, publish network stats into the GIS.
 - Streaming Binding Service*
 - Binds Source and Sink for streaming data
 - Streaming Service*
 - Create a new grid service that will facilitate the provisioning of infrastructure to support streaming data, and will provide standard mechanisms to control, archive and retrieve various forms of data streams.
- May want to reuse some functions from TREK. TREK provides archiving and playback.

* Services to be developed

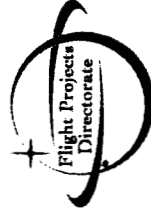
Bob Bradford, Marshall Space Flight Center, 256-544-2843

Draft



Space Operations Services Grid Project

Major Deliverables



- Interim Deliverable: Preliminary Prototype in July 2004 simulating the user based services but not fully Grid enabled
- Final Deliverable: Spaceflight Operations Services Grid in March 2005
 - Grid and Web enabled user-based services as feasible with security
 - Four Grid Virtual Organizations: Payload Control Center Operations, Science (PI) Operations, Flight Control Center Operations and Outreach
 - Quasi-operational Grid prototype that can be used by the VO disciplines
 - Recommendations for future direction
- A feasibility study with recommendations



Space Operations Services Grid Project

Potential Benefits of Grid Enabling

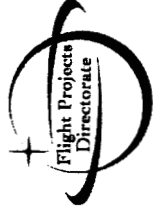


- Single sign-on allows a user to authenticate once and thus create a proxy credential that a program can use to authenticate with any remote service on the user's behalf
- Significantly reduce a scientist's need to understand the internal workings of ground support systems, e.g. logon, how to access
- Anticipated reduction in training required to operate ground systems
- Any OGSA compliant application will have secure access to all other grid resources, including the NASA's Information Power Grid high performance computers
- SOSG services can be centralized making it easier to provide and operate the required hardware and software to deploy and manage the service



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Potential Benefits of Grid Enabling (cont)



- PI sites will only need thin clients to access the services in a secure environment reducing their hardware requirements, e.g., PIs no longer need to be database administrators
- Easily create customizable portals to give the users a specific view of the grid based on individual profiles, e.g. MySOSG
- A grid enabled data warehouse will allow the PI's to 'check-in' their data, thereby giving access to others in the scientific community
- Scientists will be able to directly access and control science experiments on the ISS via the grid from very remote locations in a secure environment
- Ground based grid-accessible processing can be coupled to ISS-based applications in a seamless manner